over a solution of iodide of potassium. By means of the air pump it is easy with a gentle exhaustion to expand the gas so that it may fill the whole tube while the open end is immersed in the liquid which it is desired to introduce; on removing the pressure the gas will be in contact with the new liquid.

The lecturer exhibited some of the original tubes with which Prof. Tait and he first determined that ozone is a condensed form of oxygen, and explained a form of apparatus by means of which this important fact can be exhibited as a class experiment. A full description of this apparatus will be found in his lecture on ozone, which was delivered some time ago before the Royal Society of Edinburgh, and has since been published by the Scottish Meteorological Society. With this apparatus the lecturer has been able to determine that chlorine gas undergoes no change of volume from the prolonged action of the electrical discharge. His experiments on this subject have not yet been published, but they were made under singularly favourable conditions for discovering a very small change of volume in the gas if any such change had occurred.

The lecturer in the next place briefly alluded to the method he formerly employed for determining the latent heat of vapours of which a detailed account was given in a former communication to the Chemical Society. The apparatus employed admits of exact experiments being made on a small scale, and consequently on substances in an absolutely pure state, an object of even greater importance in inquiries of this kind than in ordinary chemical analyses. He remarked that a large field for investigation in this part of the domain of science lay comparatively uncultivated and would yield a rich harvest of results to anyone who would enter upon it.

Passing from this subject, the lecturer described a dividing and calibrating machine which he contrived some years ago for the special work in which he has been engaged, and which has given to many of his investigations an accuracy otherwise hardly attainable. He has been enabled by means of it to construct thermometers whose readings are absolutely coincident throughout every part of the scale, and to calibrate with almost perfect accuracy the glass tubes used in his pressure experiments. It would be impossible in an abstract to describe the construction of this machine, but it may be important to mention that the screw which moves the microscope or divider is a short one of remarkable accuracy constructed by Troughton and Simms.

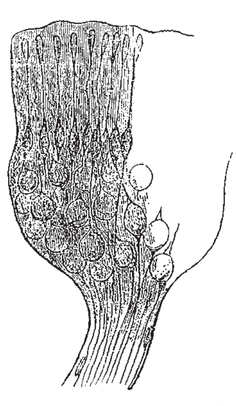
The last subject treated was the lecturer's method of investigating the properties of gaseous and liquid bodies at high pressures and under varied temperatures. By means of his apparatus, which was exhibited to the meeting, pressures of 500 atmospheres can be readily observed and measured in glass tubes—in a word, a complete mastery obtained over matter under conditions hitherto beyond the reach of direct observations. This has been effected by a novel mode of *packing* a fine steel screw, so that while entering a confined portion of water no leakage whatever occurs under enormous pressures, and also by a peculiar method of forming a tight junction between glass and metal. The lecture was concluded by a short statement of the more important results lately communicated to the Royal Society on the properties of matter in the gaseous state.

SCIENCE IN GERMANY

(*From a German Correspondent.*)

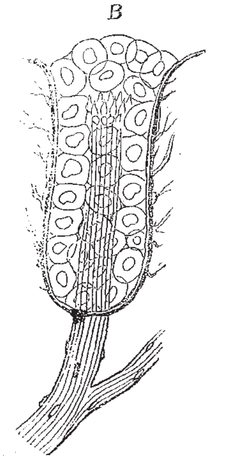
IN my last communication (NATURE, vol. xiii. p. 75), I noticed the researches of Ranke on various organs of sense of the lower animals. A new series of these researches having since appeared, I will give some account of them in what follows. Ranke (*Zeitschrift für Wissenschaftliche Zoologie*, xxv., 2 Heft. Supplement.) has studied more closely, in their physiological relations, the organ of hearing of certain grasshoppers (*Acridia*) and snails (*Pterotrachea*), and the eye of the leech, which organs were previously known in general from the researches of Siebold, Leuckart, Leydig, Boll, and others. The Acridia carry their organ of hearing on the base of the hindermost extremity. It consists essentially of a membrane, which is stretched within the body wall on a fixed ring, and an auditory nerve, which is connected from within to that membrane, and ends on it in a swelling or so-called ganglion. That membrane is undoubtedly to be compared with the membrane of the tympanum in the ear of the most highly organised animals; inasmuch as, like this, it is put in vibrations corresponding to the sound-waves in the air, and transfers these vibrations to the parts lying within. In the higher animals, these parts consist of rigid lever arrangements (small bones of the ear), which, however, are connected with the acoustic nerve not directly, but through a transmitting apparatus, which separates the vibrations produced by various sound-waves, and specially prepares them for conveyance by the nerves. In the Acridia, the whole internal conduction of the sound-waves is more simply arranged; the ganglion on the tympanic membrane consists of two different halves; in the interior the finest nerve-threads proceeding from the auditory nerve unite with large round nerve-cells, from

A



Ganglion of organ of hearing in Acridia (schema after Ranke).

B



Eye of leech (schema after Ranke).

which they proceed to the boundary of this half of the ganglion, and there end in smaller nerve-cells. The outer half of the ganglion consists of a brighter and delicate ground mass, in which very fine rods, transparent like glass, and fixed, run parallel towards the tympanic membrane; they spring out of those smaller cells, terminate on the tympanic membrane with longish thickenings, and may be regarded as the end-apparatus of the nerve-conduction. But while thus the vibrations of the tympanic membrane are communicated to the rods and from these direct, without further intervention, to the nerve-apparatus, there is not entirely wanting a weakening or damping arrangement for the sound-waves; for the ground-mass, in which the rods rest, may very well be regarded as such an arrangement. As the rods are all formed alike, the sensations of tone by the Acridia must be always homogeneous and simple; and if we may suppose that the organ of hearing of these animals is adapted to their own production of tone, by which they excite sexual desire, then their monotonous rattle agrees with the arrangement of the auditory apparatus for a simple sensation. In other grasshoppers, the Locustida, the vocal organ produces a sound compounded of more tones; and correspondingly, they have on their fore legs an organ of hearing, the rods in which are of various length and breadth, and, arranged like the wires in a

piano, evidently serve for excitation of different sensations of tone. The organ of hearing of the Acridia is then, simple, in a similar sense to that of the simple eyes which perceive light, but not colours and forms; and therefore it closely approximates to the organs of touch, which likewise render sensible simple mechanical stimuli, and are often arranged in a way similar to those organs of hearing.

The eye of the leech consists of a cup-like inflexion of the skin, which is so lined with large transparent cells that only a narrow axial canal remains. The nerve-stem which enters at the bottom of the cup, fills this canal up to a certain height, and ends there with a ganglion, while the nerve-fibres pass into small cells, whose outer end runs out into a short rod; the entire cup is coated round with a pigment skin and enveloped in muscles, which are directed partly parallel, partly at right angles to the skin surface, and therefore can draw the whole cup with its sheath inwards, or press the contents somewhat outwards. The former happens when the animal is surprised by sudden light, just as we close our eyes in like circumstances. After some time, the leech opens its eyes, a part of the glass-like cells on the rim of the open cup being pressed out in form of a compact hemisphere. In this way a pretty perfect visual apparatus is arranged. The outer glass-like hemisphere corresponds to the light-refracting medium of a more perfect eye. The mosaic of rod-cells behind receives the separate rays and conveys the stimulus to the nerves, while the pigment layer cuts off all round the light that has penetrated. Besides these eyes on the upper lip, the leech possesses on other parts of the body organs constructed quite similarly, only without a pigment skin, so that they cannot be visual organs. On the other hand, they are thrust out when the animal is feeling about, and are thus evidently organs of touch; but at the same time the organs of sight are used in the same way; and when the animal sucks in the liquids agreeable to it, it draws the upper lip with the open organs of sight into the mouth. It would appear, then, that these organs are at once the means of sensations of touch, taste, and sight. To conceive this rightly we must consider that in the lowest animals the special sensations of sense are not yet differentiated; their body is in all parts alike sensitive, and sensation can only mean, quite generally, ease or uneasiness. In a higher form of organisation, certain body-parts are, by peculiar arrangements, rendered sensitive to pressure, heat, light, and chemical stimulation. But before such a simple organ of sense develops in one direction for a particular kind of stimulus, it can also communicate simple sensations of a different kind. We ourselves know such a combination of different sensations through the same organ of sense; *e.g.* our ear, at the boundary of the tone-conductors, may feel, instead of tones, simply a vibration or a tickling, and thus has a sensation of touch like that produced in a finger-point when a vibrating tuning-fork is applied to it. Again, in our tongue, sensations of taste, smell, and touch are mixed together. Thus the organ of hearing of Acridia, which can only feel hissing noises, but no tones, may be compared, in the quality of its sensation, to an organ of touch; and of the visual organ of the leech, it may perhaps be said that it receives somewhat of the sensation of touch and taste. In short, Ranke holds these organs to be of such a kind that the general feeling is not yet fully separated into the categories of touch, hearing, seeing, &c.

The ear of the Pterotrachea had long been known as a bladder, on whose inner wall are tufts of hair, the motions of which throw to and fro the otoliths or small spherical stones freely suspended within the bladder. It was believed that these continuous motions were connected with the sensation of hearing. Ranke proves, however, that they are merely due to convulsive movements of the animal in dying under the observation, and that the acoustical apparatus proper consists of a ganglion in the bladder wall, organised similarly to that in the Acridia. In the normal condition, the otoliths are pressed by the surrounding hair-tufts against the acoustical apparatus only in the case of stronger sound-stimuli, and they have then a damping action.

NOTES FROM THE "CHALLENGER"[1]

PROF. THOMSON in this paper after briefly referring to a visit to the Hawaiian crater of Kilauea, proceeds as follows:—

In the section between Hawaii and Tahiti, except at one station close to Tahiti, where the depth was 1,525 fathoms, the depth ranged throughout the section from 2,000 to 3,000 fathoms with a mean of about 2,600 fathoms, and the nature of the bottom was very uniform. Except in the neighbourhood of the groups of volcanic islands, where it was found to be largely composed of volcanic *débris* and shore mud, it consisted mainly of red clay, in many of the soundings containing a large admixture of the decaying shells of Foraminifera, and in almost all including a large proportion of manganese peroxide in the form of concretions from the size of a nut to that of an *Orbulina*, and passing into fine, almost microscopic granules visible under a low power in every sample of sounding. In two patches the siliceous skeletons of Radiolarians were so abundant as almost to entitle the deposit to the name of "Radiolarian ooze," and a patch between these, nearly halfway between Hawaii and Tahiti, in its abundance of surface Foraminifera approached a true "Globigerina ooze." The larger samples of bottom brought up in the dredge or trawl had of course generally the same character as the contents of the "Bailie" sounding-tubes; but in these large manganese concretions, up to the size of an orange, or even larger, were collected in quantity, the greater part of the red clay being usually washed out.

The surface-temperature naturally rose in passing southwards from Hawaii towards the equator, and again sank from the equatorial belt towards Tahiti. The isothermobaths[2] between 14° C. and 24° C. gathered together and approached much nearer to the surface in the region of the trade-winds, owing no doubt to the rapid removal to the hot surface-water by evaporation and the driving action of the wind. Thus the isothermobathic line of 14° C., which is at a depth of 200 fathoms a little to the north of Tahiti, is at a depth of 100 fathoms on the line. In the Atlantic all the isothermobaths seem to participate in the rise in the region of the trade-winds; it is not so in the Pacific; the lines below 14° C. uniformly sink, forming a depression which extends from lat. 10° N. to lat. 10° S.; thus the isothermobath of 5° C., which may be taken as a type of these deeper lines, is found in lat. 10° N. at a depth of 450 fathoms; and in lat. 10° S. at the same temperature within the limits of error of observation, while in lat. 2° 34′ N. it is found at 625 fathoms. The point where the isothermobaths gather together most markedly and approach nearest to the surface is a little to the north of the northern border of the equatorial counter current. This fall of temperature is so decided as to indicate some special areas of cold water; and it may possibly be to some extent due to the pressing up of deeper and therefore colder layers of the colder trade-current against the hot stream. In the equatorial region between lat. 10° N. and 10° S. there is a belt of water about 80 fathoms in thickness at a temperature generally over 25° C., and the whole of this water, with the exception of the narrow band of the counter current, is running to the westward at the rate of from forty to seventy miles a day.

The bottom fauna over the whole of the manganese area is very meagre, both as to number of species and number of individuals.

After a week's stay at Tahiti the *Challenger* left the harbour of Papeete on the 3rd of October, and arrived at Valparaiso on the 19th.

[1] "Preliminary Report to the Hydrographer to the Admiralty, on some of the Results of the Cruise of H.M.S. *Challenger* between Hawaii and Valparaiso," by Prof. Wyville Thomson, F.R.S., Director of the Civilian Scientific Staff on board. Paper read before the Royal Society.

[2] The word *Isotherm* having been hitherto so specially appropriated to lines passing through places of equal temperature on the surface of the earth, I have found it convenient, in considering these questions of ocean temperature, to use the terms *Isothermobath* and *Isobathytherm*; the former to indicate a line drawn through points of equal temperature in a vertical section, and the latter a line drawn through points of equal depth at which a given temperature occurs. Isothermobaths are shown in a scheme of a vertical section, such as Plate II. Isobathytherms are of course projected on the surface of the globe.